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Work Histories--Evaluating New Participatory Methods
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ABSTRACT

Worker medical or monitoring records, commonly available for production workers are virtually non-existent for construction workers hired on an as-needed basis at Department of Energy sites. Construction workers at nuclear weapons production sites can be exposed to a wide range of hazards including radiation, toxic chemicals, and noise. Worker recall of exposures is difficult because the sites are very large, may have hundreds of buildings or work sites. In addition, construction workers may not be familiar with the health effects of the materials in the workplace to which they are exposed, and national security secrecy regulations prevented workers from discussing their experiences with others. A comprehensive database (institutional history) of buildings and other sites at the Oak Ridge Reservation was assembled. It provides information that describes potential health hazards to workers for use in evaluating potential exposures. Traditional occupational history interviews were conducted initially with one group of carpenters. Another group of carpenters was interviewed using various prompts (photos, or maps or focus groups of persons likely to have worked in similar locations). Of these methods, site maps were found to provide a significant improvement in recalling information concerning where they had worked. A validation study was conducted with former Oak Ridge Reservation construction workers comprised of several crafts in addition to carpenters. This study demonstrated that site maps are a powerful memory trigger significantly improving recall of sites where an individual worked. These findings are extremely valuable in determining workplace exposures of construction trades where exposure assessments are lacking.

SIGNIFICANT FINDINGS

The provision of detailed site maps was found to provide a significant improvement in triggering memories during interviews of workers in the construction trades who worked at complex sites.

As part of the interview, workers were asked to mark maps of the site to indicate locations where they had worked. By comparing the marking map data with a list of buildings or other sites from a database of known toxic or radiation exposures, workers can be triaged into specific medical surveillance exam modules. It is much more efficient to provide medical exams for workers targeted to their likely work-site exposures than to provide a battery of tests for unknowns which may not be medically appropriate and considerably more expensive.

The database that contains the institutional history of building construction parameters and processes since 1940 has been developed for Oak Ridge sites K-25, X-10, and Y-12.

The maps did not work equally well for all members of the cohort because it included some former workers who are retired and have been away from the site for up to 25 years, as well as those whose visual acuity was insufficient for them to see the maps clearly. Some workers attributed their low number of responses to memory loss possibly attributable to exposures or the effects of aging.

At nuclear weapons plants, workers who did not have a security clearance were usually taken in a vehicle with no passenger windows from the entry point to the workplace where they worked in the presence of a security escort. These workers had no idea where they were working on the site or how the site's physical layout appeared.

USEFULNESS OF FINDINGS

- These findings, i.e., that maps are an extremely effective memory trigger, are extremely valuable in determining workplace exposures of construction trades where methods of retrospective exposure assessment are lacking. This information will also allow targeting of high risk work sites in a very complicated operation such as exists at nuclear weapons plants and provide information useful in interventions to reduce exposures.
- The database (institutional history) can be coupled with interviews to help provide information about potential past exposures.
- The institutional history database is available for use in epidemiological studies of workers at these sites (K-25, X-10, Y-12) at the Oak Ridge Reservation.

SCIENTIFIC REPORT

A. Background.

The specific aims of this project included: (a) assembling available documents on the institutional memory of the Oak Ridge Reservation and supplementing them where necessary; (b) conducting traditional occupational history interviews; (c) conducting occupational histories using innovative techniques including prompts during one-on-one interviews, and focus groups of persons likely to have worked in similar locations/activities; (d) comparing the results and documenting the best means of identifying workers with higher risks for cost-efficient medical surveillance; and (e) using the method found to provide the best exposure history at a second site during the third year of the research.

During the course of this project, a comprehensive database (institutional history) of buildings and other sites (tank farms, waste disposal pits, etc.) at the Oak Ridge Reservation was assembled. The database includes building number, construction date and materials used, unique features, renovations, processes that occurred in a building or an area, accidents/incidents, known and inferred hazards, and the reference materials used as the source of the information (Bingham, et.al., 1999). The institutional history database provides information that defines potential hazards for each worker and can be used to evaluate potential exposures and guide the selection the most appropriate medical screening tests for each worker. Database citations for two Oak Ridge Reservation buildings are included in Appendix A.

Traditional occupational history interviews for construction trades workers can be a difficult process because the number of sites where work occurs can be quite large and the duration of employment at any one site can be as short as a few days which has been shown to influence the worker's ability to recall information. (Bond, et. al., 1988)

Bystander exposures can also occur. Construction trades workers may be unaware of the past or present processes or activities in the work area. This situation is further complicated when the work site is an area where military or national security concerns may limit the information

provided to the workers and secrecy regulations may prevent workers from communicating their observations or concerns to health care professionals.

Worker medical or monitoring records, commonly available for production workers, are virtually non-existent for construction workers hired on an as-needed basis. Therefore, for construction workers at Department of Energy facilities, the traditional interview may not capture important exposure information and there are no alternate sources of information available to supplement the interview.

B. The Study

1. Procedure--Phase I:

The purpose of this study was to compare three techniques of enhancing long term autobiographical memory, specifically recall of occupational job history. In Phase I, carpenters working as sub-contractors at the Oak Ridge Reservation were asked to supply job history information, both before and after working with the memory prompting techniques. They were first sent a questionnaire and then interviewed by phone using a set of traditional occupational history interview questions. Approximately six months later they were re-contacted and randomly assigned into one of three groups for testing innovative methods of data collection using various memory triggers, or to a fourth group which will receive no memory triggers. Assignment was stratified by most frequent work location (building or site where the carpenter most frequently worked). This stratification ensured that each "method" group had representation from all three plants (X-10, Y-12 and K-25) and various job activities. Following the memory trigger "treatment" the worker was again interviewed, using the same occupational history questions as used in the first interview.

Methods Group A members were given memory triggers for work location. This group viewed detailed maps of the site containing color coding for specific areas such as production areas, tank farms, burial grounds, power plant, parking lots and security gates, etc. Building numbers were visible on the map. Building numbers also were listed on the map legend.

Methods Group B were given memory triggers for site history and job activities. A member of the study team presented a narrative of a history of production activities at the site, as

well as described details in various photos of the site, which were on a display board. The display included photographs of plant sites, various processes, and the interior of some buildings (such as the Graphite Reactor at X-10 now on the National Register of Historic Places).

Methods Group C received the same information as presented to both Groups A and B, but in addition participated in a focus group discussion with other carpenters who also had an assignment at the same building on the site.

Group D did not receive any information for memory triggering; they were just asked to come for a second interview.

2. Results--Phase I:

Of the three methods described in Phase I, site maps were found to provide a significant improvement in recall of the number of buildings and other places where workers had worked at the complex sites. The mean and (standard deviation) of the numbers of buildings/areas participants reported working during the telephone interview was 6.7 (6.7). This value improved slightly to 10.4 (12.6) during the in-person interview, although the increase is not statistically significant ($F=2.1$, $p=0.16$). In contrast, when participants were provided with maps, the mean number of areas was 26.7 (33.8). This is statistically significant increase in recall as compared to the personal interview ($F=29.07$, $p<0.0001$). (Rice, et.al., 1998)

3. Procedure--Phase II:

Phase II occurred after statistical analysis of the Phase I data, which demonstrated that Method A (Maps) were found to be a significant improvement in interviewing construction trades at a complex site. During the last year of the project, workers other trades were interviewed about their occupational history, both before and after viewing work locations on detailed maps. Questions used during Phase II interviews were identical to those used for the Medical Surveillance Program for members of the building trades at the Oak Ridge Reservation.

4. Results--Phase II:

In Phase II, the mean and standard error of the difference between the number of buildings and areas recalled pre-map and post-map were calculated for each craft. The statistical significance of these differences was determined by the nonparametric Wilcoxon sign rank test and shown in table 1. This study validates the use of maps as a trigger to improve recall of work sites by construction workers at complex work locations.

Table 1.

Craft	N	Mean Diff.	Std. Error Diff.	P-value
Electrician	17	57.0	15.9	0.0001
Laborer	10	18.8	6.9	0.0078
Other	33	27.1	6.7	0.0001

C. Detailed Methods of Data Collection:

1. Cohort Identification and Location:

Various sources of information were used to identify members of the building trades who formerly worked at the Oak Ridge reservation, and to locate a mailing address. For Phase I, lists of names and addresses of carpenters were obtained from United Brotherhood of Carpenters Local 50 (Knoxville), Rust Engineering, as well as a file from Oak Ridge Associated Universities. Subjects for data collection in Phase II were obtained from the general cohort list for the Medical Surveillance Program with contact information supplied by various trade groups in Oak Ridge and Knoxville. In order to test the usefulness of the technique on another craft, electricians and laborers were preferentially recruited for the "memory enhancement methods study" although other crafts also were enrolled in they were scheduled for occupational history interviews on the days that data collection for this study was being performed. For both phases, on-line phone directories also were used for mailing addresses and phone numbers. Vital status information ("deceased") was obtained from local trade group records and from the Social Security Death Benefit file.

2. Pilot Test:

Before finalizing recruitment and data collection methods and the schedule of occupational history questions, the researchers conducted a pilot study. Using a set of open ended questions, phone interviews were conducted on seven carpenters followed by in-person interviews with eleven different carpenters in October, 1996 at the Local 50 union hall. The

responses received during these interviews allowed the investigators to refine the questions for the mailed questionnaire for Phase I, and provided information for constructing the task lists used in the phone and in person interviews. Quality and quantity of data obtained by phone interviews were comparable to that obtained from in-person interviews. Since the feasibility of obtaining a large group of subjects willing to come for two in-person interviews was doubtful, the investigators elected to conduct all first interviews by phone.

3. Recruitment

Phase I subjects were first recruited by mailing a packet containing a letter of invitation to participate in the study from local union leadership, consent form, short questionnaire, and postage prepaid return envelope. Workers were given an explanation of the project and an outline of the events of study participation. Non-responders were sent a bi-fold follow-up post card, with a return section allowing check off response to request another copy of the questionnaire or to indicate that the person never worked at Oak Ridge. The response section of the postcard marked "other" allowed a family member to notify the researchers of the death of a former worker. Various methods of outreach were used both before and during recruitment, including the preliminary mailing of a newsletter, announcements at union meetings and visits by the Principal Investigator to a union meeting and trade council meeting.

Recruitment packets were mailed in batches of 100 to allow sufficient resources for timely follow-up. Packets returned by the post office as "undeliverable" were processed by using on-line directories to look for new addresses and occasionally using a phone call to verify that the address was for the correct person, and then re-sent to the new address. A tracking database was constructed to store information about attempts to contact, report of having "never worked at Oak Ridge", or death of the worker. These ineligible workers were sent a thank you note for their initial participation.

Study participants were instructed to return the signed consent in the envelope with the completed questionnaire, and were re-contacted if this was not received. No telephone interviews or other methods of data collection were performed without a signed consent on file.

4. Phase I Interviews

During the first phase of the project, carpenters were scheduled for one-hour individual phone interviews for baseline collection of occupational history data. These data were then compared with data obtained at the time of the second occupational history data collection, to assess if memory triggers resulted in greater recall and to ascertain improvement in construct validity. Information from the phone interview also was used to determine most frequent work location, which then was used for stratified random assignment to one of the three methods groups for the second interview.

a) Preparation For Phone Interview:

After receiving a completed questionnaire and consent form, workers were contacted by phone to schedule a phone interview. Workers also were sent a copy of their completed questionnaire so that they could refer to it during the phone interview, as well as a copy of the “task list” to view during the interview. Returned questionnaires were reviewed for incomplete or confusing information, which was clarified at the time of scheduling the phone interview. Interviewers also were instructed to construct a simple occupational history timeline for the worker, prior to the phone interview.

b) Interviewer Training:

For Phase I, interviewers were graduate students, research assistants or other professional staff at the University of Cincinnati. Interviewers received training in background and objective of the research project, history of the Oak Ridge reservation and activities of carpenters, and interviewing techniques. Interviewers first role-played “practice interviews” in the presence of the study epidemiologist, who also monitored initial phone interviews for consistency in delivery of questions and secondary probing questions. Written specifications were developed for each question in the interview schedule, so that responses to carpenters’ queries about the questions would be standardized. Data recording forms were audited for completeness of information.

c) Phone Interview

Current or last assignment:

After collection of usual demographic information (age, sex, educational level) the worker was asked to "think about your current assignment at Oak Ridge". Retirees were asked to "think about your last assignment at Oak Ridge". Previous research has demonstrated that starting with the "current" or most recent job rather than the "first" job should yields more information. In a study of long-term autobiographical memory, Whitten and Leonard (1981) found that the probability of recalling an item from autobiographical memory is primarily a function of recency; the recall of one item can indirectly aid the recall of contiguous items.

The carpenter was then asked for the date (month and year) when he began working on that assignment. An assignment was defined as "work on one project in one location". If the carpenter moved on to a new location (new building or new floor within a building), he was presumed to be on a new assignment. Asking first about the start date of each assignment precipitated questions about the operational definition of an assignment, allowing the interviewer to clarify, and therefore standardized the concept of a work assignment. Specifications were written for the interview schedule, so that the interviewers' responses to worker inquiries about the meaning of questions would be standardized.

Next, the worker was asked to name the building in which he was currently working, and to describe activities of his work. The interviewer recorded these activities verbatim, and asked probing questions to obtain additional information. Examples of these probing questions were:

What kinds of equipment did you use on this assignment?

Did you have to first remove any old structure or equipment before you began this remodeling or new installation?

What were the steps that you needed to take in doing this remodeling/new installation?

Workers were asked to review the mailed task list and to indicate a frequency for each activity. The carpenter also was asked whether he spent time at any other location(s) of the Oak Ridge plant, other than the primary location of his assignment (wood shop, electrical shop)? During that assignment, how many total hours per week were spent at that Oak Ridge plant? Did his job require that he go off site to procure materials, etc.?

Questions about protective practices and equipment completed the loop of questions regarding the current job. The worker was asked about protective clothing, showering after work, and hand washing practices prior to eating or drinking. Other specific questions were directed toward the use of respiratory protective equipment, including type of mask and job activities or work locations requiring use of a mask.

First assignment:

The next step of the interview process was to focus on the first job assignment of the carpenter at Oak Ridge. Based on previous data collection experience, the investigators of this study feel that, after being asked about their current or last assignment, workers are most comfortable in providing historical job information if they are asked about events in the order that they occurred. Carpenters were asked to "think back to your first assignment at Oak Ridge", and to recall the start date (month and year) of that assignment.

Questions will then follow the same pattern as was used for the current assignment: work location, job activities including probing questions, frequency of job activities, use of protective practices and equipment.

Other location:

Following completion of the loop of questions about the first work assignment, the carpenter was asked about the location (building or area) of other assignments at Oak Ridge. The interviewer then compared locations mentioned with a list of eighteen "Locations of Special Interest" and used a random number table to select one of the "special interest" locations for further questions. The carpenter was then asked about the equipment used at each assignment at this location, and the frequency of tasks performed, presence of hazardous materials and use of protective equipment.

Completion of interview:

Final interview questions asked about the wearing of radiation dosimeter badges, involvement in major fires and decontamination events. A final open-ended question asked for any other information the carpenter felt important to provide.

The interviewer then rated his/her perception of the ability of the carpenter to recall information and level of cooperation with the interview process.

d) Random Assignment Of Study Subjects To One Of Four Study Groups:

A computer generated random number was created for each study participant and was used for assignment to one of four study groups. The study participant with the highest number was assigned to Group A; participant with the second highest number will go to Group B, etc., until all study participants are assigned.

Prior to random assignment, the most frequent work location (X10, Y12 or K25) of each carpenter was identified. As random assignments were made, the proportion of carpenters in each "methods group" representing each work location was monitored. An "upper limit" for the proportion from any one building in any group was established prior to randomization. If, at any time during the randomization process, that "upper limit" is exceeded, the study participant will be assigned to the next group. The next study participant, according to random order, was assigned to the group that was missed.

e) Presentation Of Memory Triggers:

Group presentations of memory triggers and second occupational history data collection took place during the second year of the project.

During group sessions, information was presented to carpenters by both study investigators and union representatives. A formal script was prepared and followed for each session, in order to standardize the content of the presentation and to ensure that it was identical for

each session. Following the information session, interviews were conducted using the identical set of questions used for the phone interviews.

Group A subjects were presented with memory triggers for work location, specifically maps and pictures of the site. Maps of the site and pictures of buildings were obtained from the American Museum of Science and Energy, and from the Department of Energy Geographic Information System (GIS) resources. These very large, detailed maps were color coded for specific regions such as production areas, tank farms, power plant, parking lots and security gates. Each building number was visible on the map. The map legend contained building numbers with corresponding building names.

One of the investigators presented information on the history of the buildings at the site, using a previously prepared script. Use of a script standardized the presentation of this information, so that it was identical on each day of data collection. The presenter also reviewed each map with the study subjects, pointing out well-known locations such as key production buildings, cafeteria building, medical building, maintenance shop, etc.

Group B would receive a presentation of memory triggers for production history and job activities. Many pictures of production activities are available at the Oak Ridge Reservation library. These pictures were enlarged and mounted on foam core board, and also placed in a picture album for closer viewing. A member of the study team presented a narrative of a history of production activities as well as described details in various photos. Consistent with the methodology for Group A, the presentation followed a previously written script

Group C would receive both the presentation on history of production given to Group B. They were then be asked to place their chairs in a circle for a group discussion led by a trained facilitator who followed a schedule of questions for discussion. Questions focused on delineation of specific job activities related to production processes, and changes that were made over time. The facilitator also posed questions on policy vs. actual use of personal protective equipment.

Group D were asked to come to the interview site at a different time and were not shown any visual aids or engaged in any type of discussion. They were merely re-interviewed.

At the completion of the memory trigger presentation, study participants were immediately let to the second interview. If any had to wait, informal discussions were discouraged since they could mimic the memory trigger function of the focus group. Therefore, while carpenters were waiting for second interviews they were in the presence of either a union official who discussed union related issues, or study investigators who curtailed discussion of individual job history information

f) In Person Interview:

Following the memory trigger presentations (or unrelated video) all study participants again were interviewed for occupational history data collection. Whenever possible, the interviewer who conducted the first data collection for that carpenter also conducted the second interview. Questions were identical to those posed during the phone interview. A printed copy of the task list was again viewed by the carpenter as the interview asked the related questions.

After interview questions, study subjects were asked to study a large map of the primary plant (X-10, Y12, K25) at which they worked and mark on a smaller paper map all of the buildings or areas in which they worked. They were instructed to place an "X" over each location or area. Additional information recalled during this map marking was not recorded on the interview data collection forms.

The carpenter was then given a short questionnaire, which asked the subject directly about the usefulness of the memory trigger methods. Separate questionnaires were designed for Group A, B and C participants. Lastly, the interviewer again rated his/her perception of the carpenter's ability to recall job history information and willingness to cooperate with the interview process.

5. Phase II Interviews:

During Phase II of this project, a different set of workers in two other trades (electricians and laborers) were interviewed about their occupational history, both before and after viewing work locations on detailed maps. The method found to provide the best

exposure history with carpenters at the Oak Ridge Reservation in the first phase of the project was initially proposed to be tested at a second site, the Hanford Reservation in the State of Washington. However, travel costs for a project at Hanford became prohibitive, so the validation was conducted at Oak Ridge using another group of construction workers comprised of various crafts (electricians and laborers, plus roofers, pipefitters, boilermakers, painters, etc).

a. Recruitment

This portion of the methods study was conducted within the framework of the DOE Medical Surveillance Program for member of the building trades at Oak Ridge, and the questions used during Phase II interviews were identical to those used for the Medical Surveillance Program occupational history data collection. However, interviews for this methods study were conducted on designated days, with one designated, specially trained interviewer performing all of the data collection. On these days, also, the maps were obscured from view as the workers arrived, so they would not see them prior to the pre-map interview. Of those scheduled on these days, three were excluded from data collection. One worker was excluded for vision deficit; two were excluded for general memory deficit, stating that they “couldn’t remember anything”. Interviews were conducted between February and June, 1999, and took approximately 1.25 hours, including the time spent viewing maps.

b. Pre Map Interview:

Baseline data were collected during an interview conducted before the worker viewed any maps. After collection of the usual demographic information and dates and duration of work, the worker was asked, “at which plant did you work for the most time?” The worker was then asked to recall, without any visual aids or prompts, all of the buildings “that you worked in or around” at that plant.

The worker was then given a laminated card with a list of tasks involving mercury, hot work (cutting, burning, welding), and transite work, and asked specific questions about those tasks including “first time?”, “how long?”, and “how often?”. For frequency (“how often”), workers were asked to rate tasks using a scale ranging from 1=rarely to 5=constantly.

Finally, the worker was asked to think about all three plants (X-10, Y-12, and K-25) and to name the four locations (buildings or outside areas) “in which you worked the most time”.

c. Viewing Maps:

The worker was then were taken to an area where large maps of the site were viewed, and directed to the map(s) of the plant(s) at which s/he worked. The interviewer gave the worker a brief verbal orientation to the maps, pointing out parking lots, entry security gates, cafeteria, or other non-production locations which would be familiar to most workers. One or more large paper maps were given to the worker, which were identical in format and size to the wall map. As before, the worker was asked to place an “X” on the paper map over each location or area in which s/he had worked.

d. Post-Map Interview:

After marking the paper maps, the worker was led back to the interview station, and administered the standard occupational history question set, minus the demographic, work date, and general information questions that had been included in the pre-map interview. During this interview the worker was asked about a much longer list of tasks, repeating the questions from the pre-map interview but also including tasks related to blasting, installing/repairing equipment, operating heavy equipment, applying or grinding/scraping paint, work around chromium, lead, nickel or beryllium, and work with solvents.

Questions #12 of the post-map interview focused on 65 locations of “special interest” because of their potential for radiation or toxic exposure. Of these 65, there were 15 buildings from X-10, 31 buildings from Y-12, and 14 buildings from K-25, as well as 5 other locations such as waste pits. While the worker was viewing the maps, the interviewer noted which of these buildings the worker had marked, and noted them on the Questions #12 recording tool. After returning to the interview station, the worker was asked about duration of work at some of those locations, where duration of work would determine eligibility for components of the medical surveillance exam.

e. Memory Recall Method Questionnaire:

Similar to Phase I, workers were asked to complete a “memory recall method” opinion questionnaire following completion of the interview. When completed, the worker was thanked for participating in the occupational history interview and given information about the “next steps” of the medical surveillance program. After the worker had left the office, the interviewer rated his/her perception of the workers ability to recall job history information and willingness to provide information.

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University of Cincinnati Institutional Review Board, Harry Rudney, Ph.D., Chairman.

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Journal Article

Bingham, E., Rice, C.H., McDougall, V., Cook C. Exposure profiles of former construction workers. Eur J Oncol 3 (4):329-334, 1998.

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Anticipated Future Publication

Validation of Memory Triggers in Construction Worker Histories